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Reichle

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(54) **PLUG CONNECTOR PART**

(75) Inventor: **Hans Reichle**, Wetzikon (CH)

(73) Assignee: **Reichle & De-Massari AG**, Wetzikon (CH)

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(51) **Int. Cl.**[7] **H01R 24/00**
(52) **U.S. Cl.** **439/676**; 439/941
(58) **Field of Search** 439/941, 676, 439/644, 405

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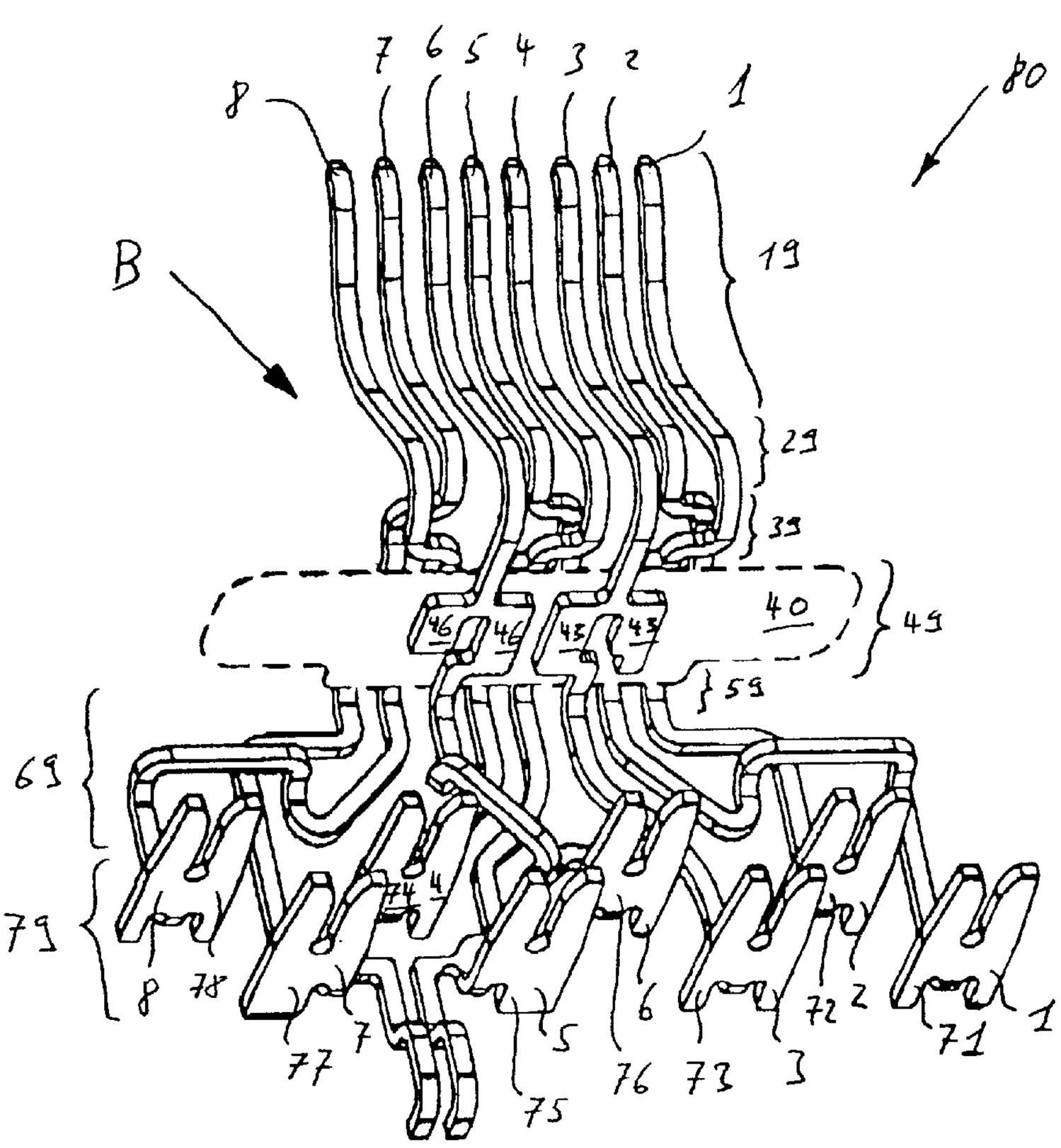
Primary Examiner—Gary F. Paumen
Assistant Examiner—Ann McCamey
(74) *Attorney, Agent, or Firm*—Nath & Associates PLLC; Gary M. Nath; Marvin C. Berkowitz

(57) **ABSTRACT**

A plug connection part, in particular for RJ45 plug connectors, comprises a multiplicity of conductor paths which have at one end a contact spring and at the other end an output contact, where the contact springs starting from an end facing away from the output contact run towards the output contact, and where the conductor paths run at least partly mutually crossing in a compensation section following the contact springs and the conductor paths along a part length of the compensation section lie at least partly above each other and run electrically separated by means of an insulator arranged in between.

13 Claims, 3 Drawing Sheets



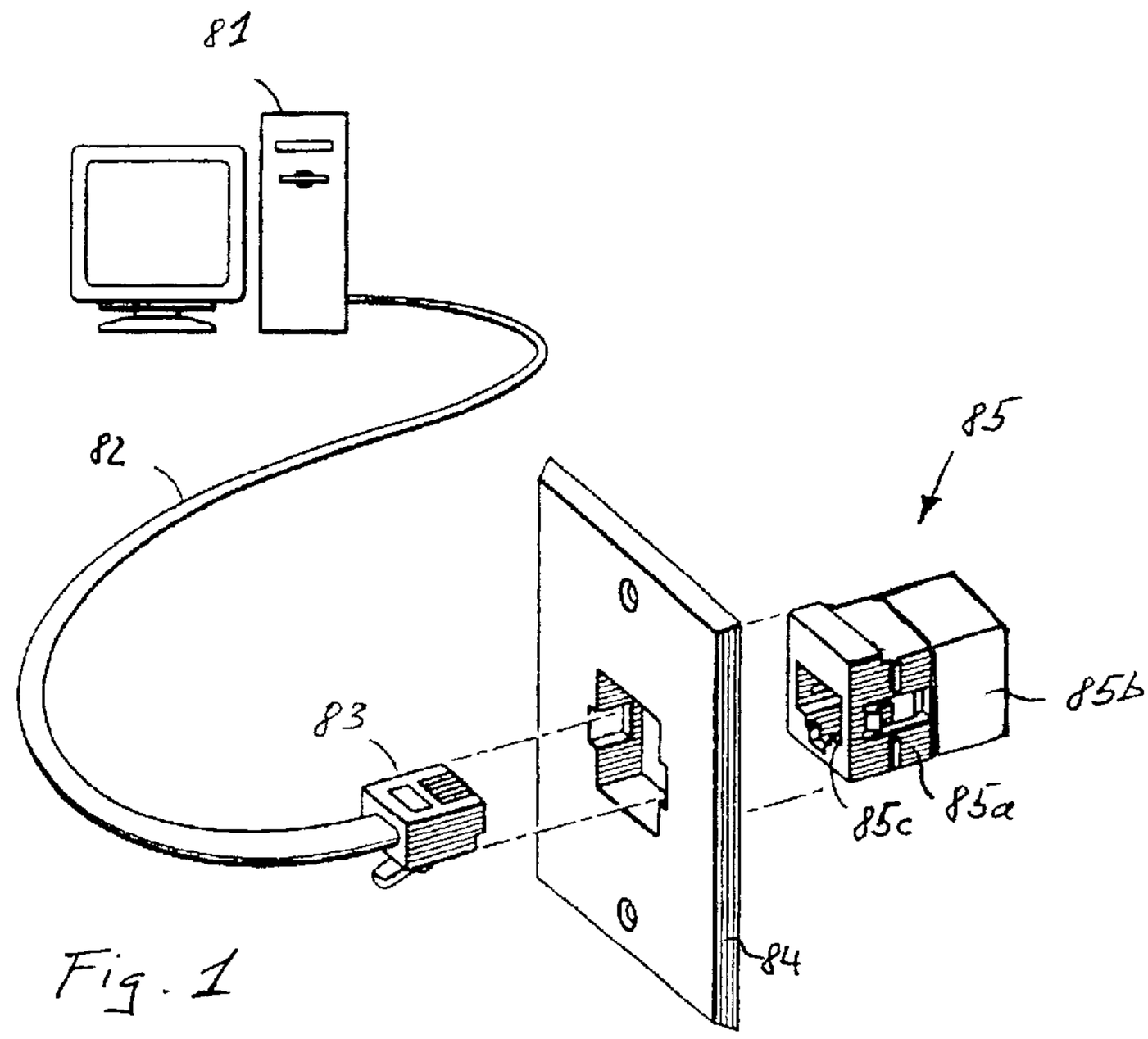

81
82
83
84
85
85b
85c
85a

Fig. 1

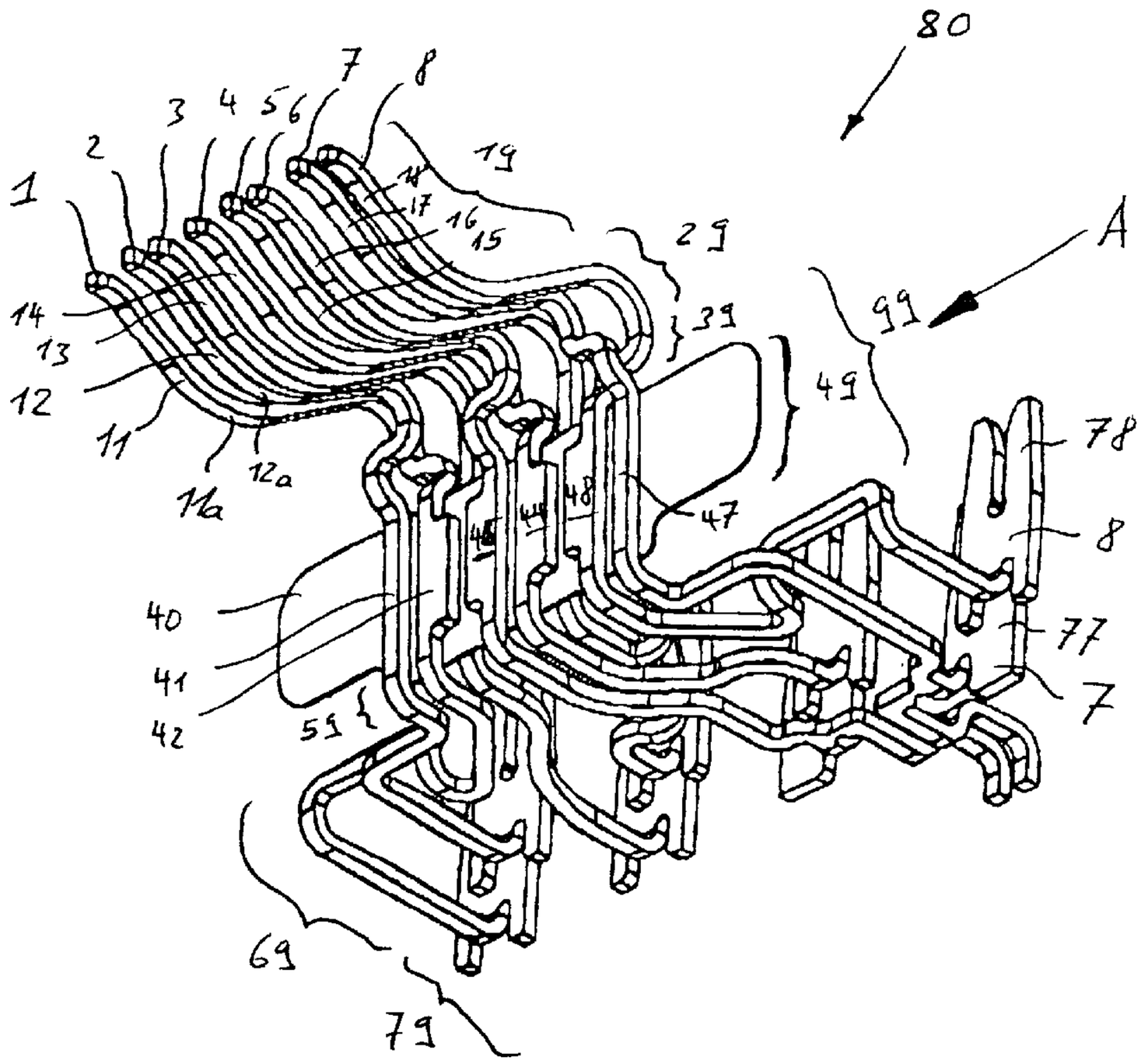

80
A
99
49
29
39
1
2
3
4
5
6
7
8
19
18
17
16
15
14
13
12
11
11a
12a
40
41
42
51
48
47
78
77
69
79

Fig. 2

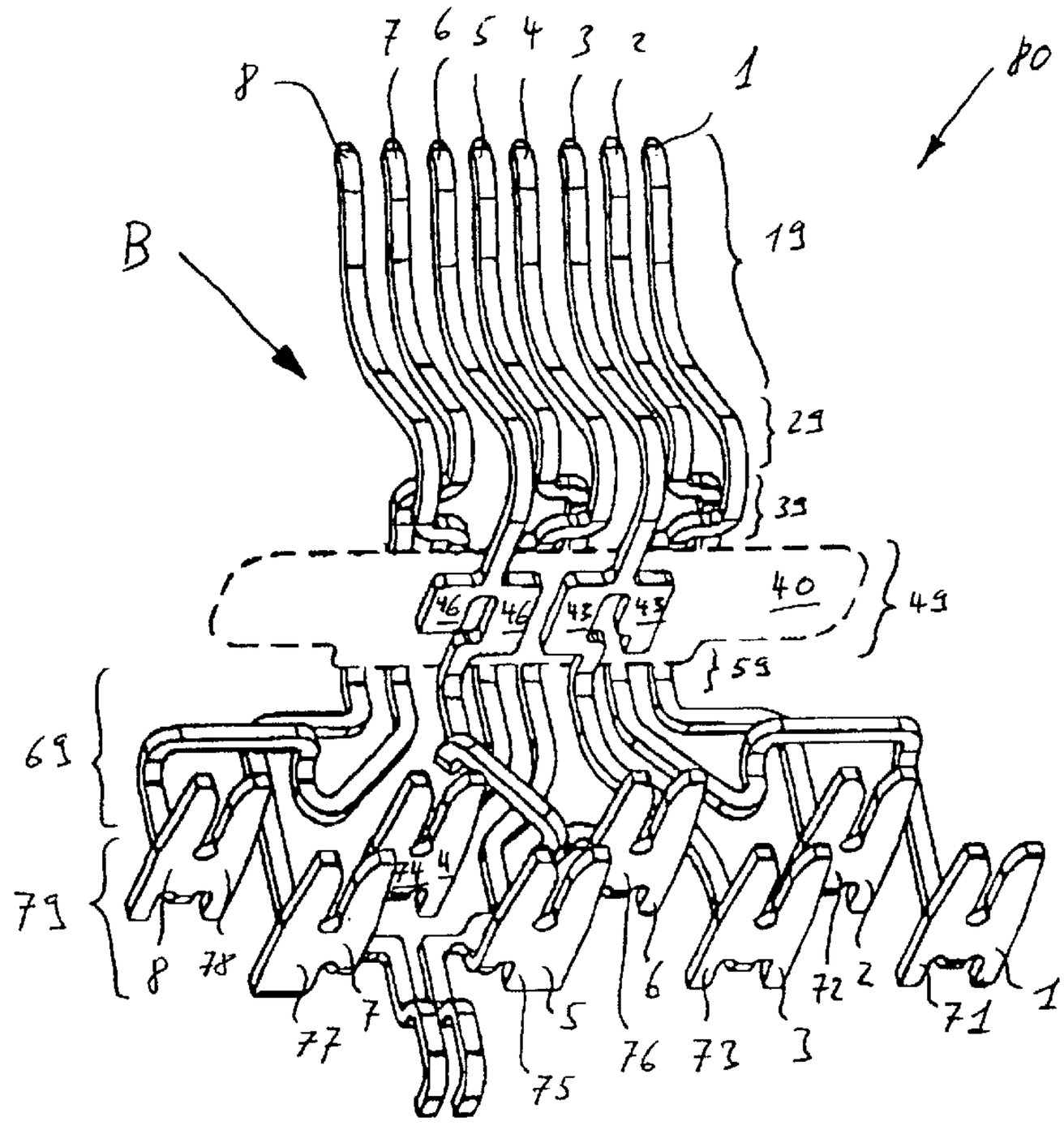


Fig. 3

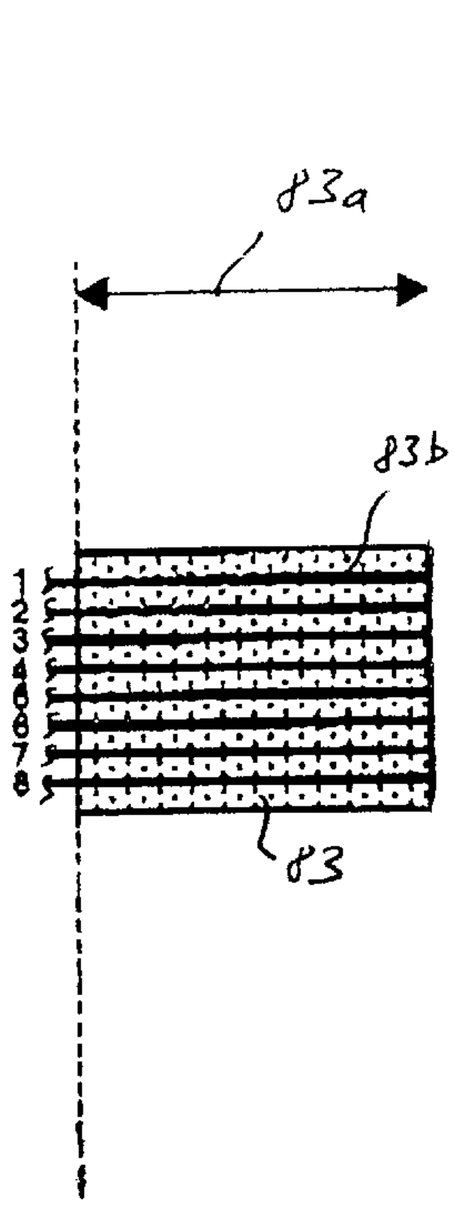


Fig. 4a

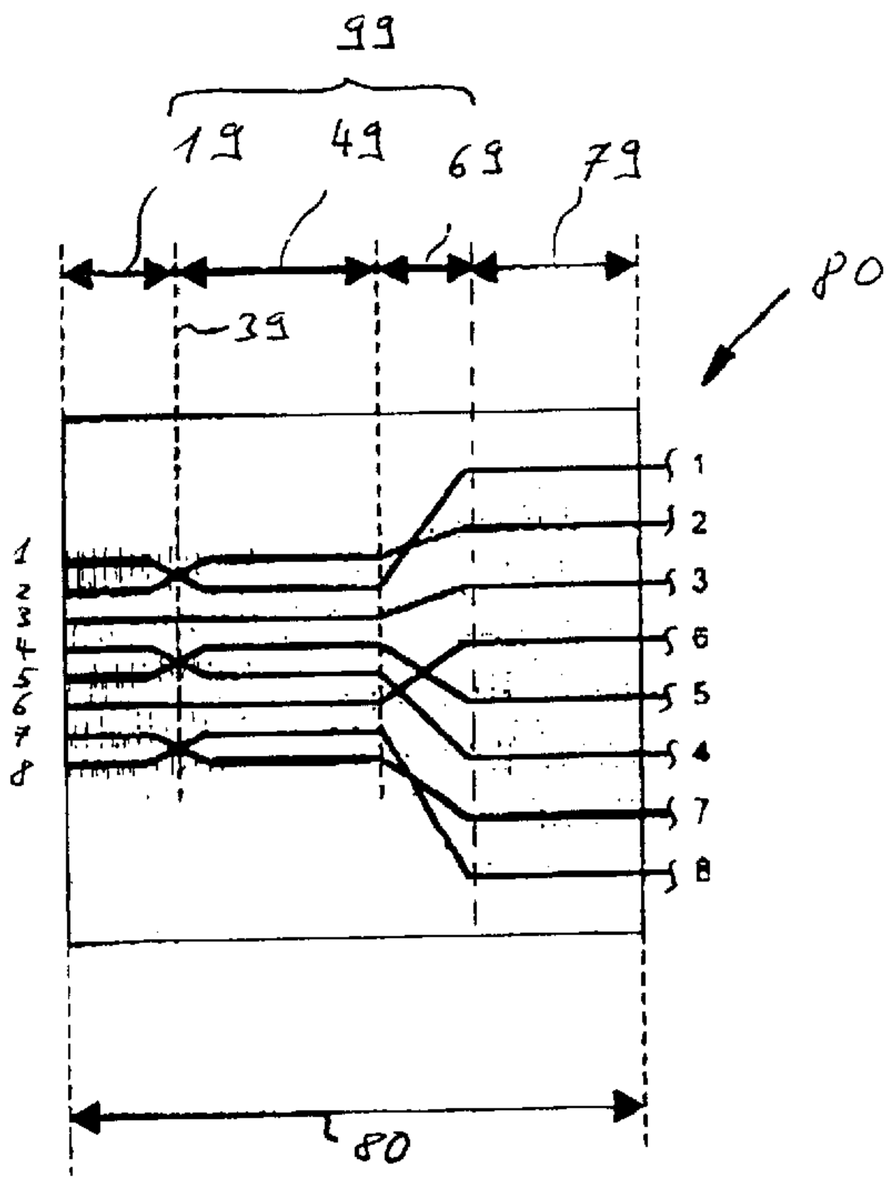


Fig. 4b

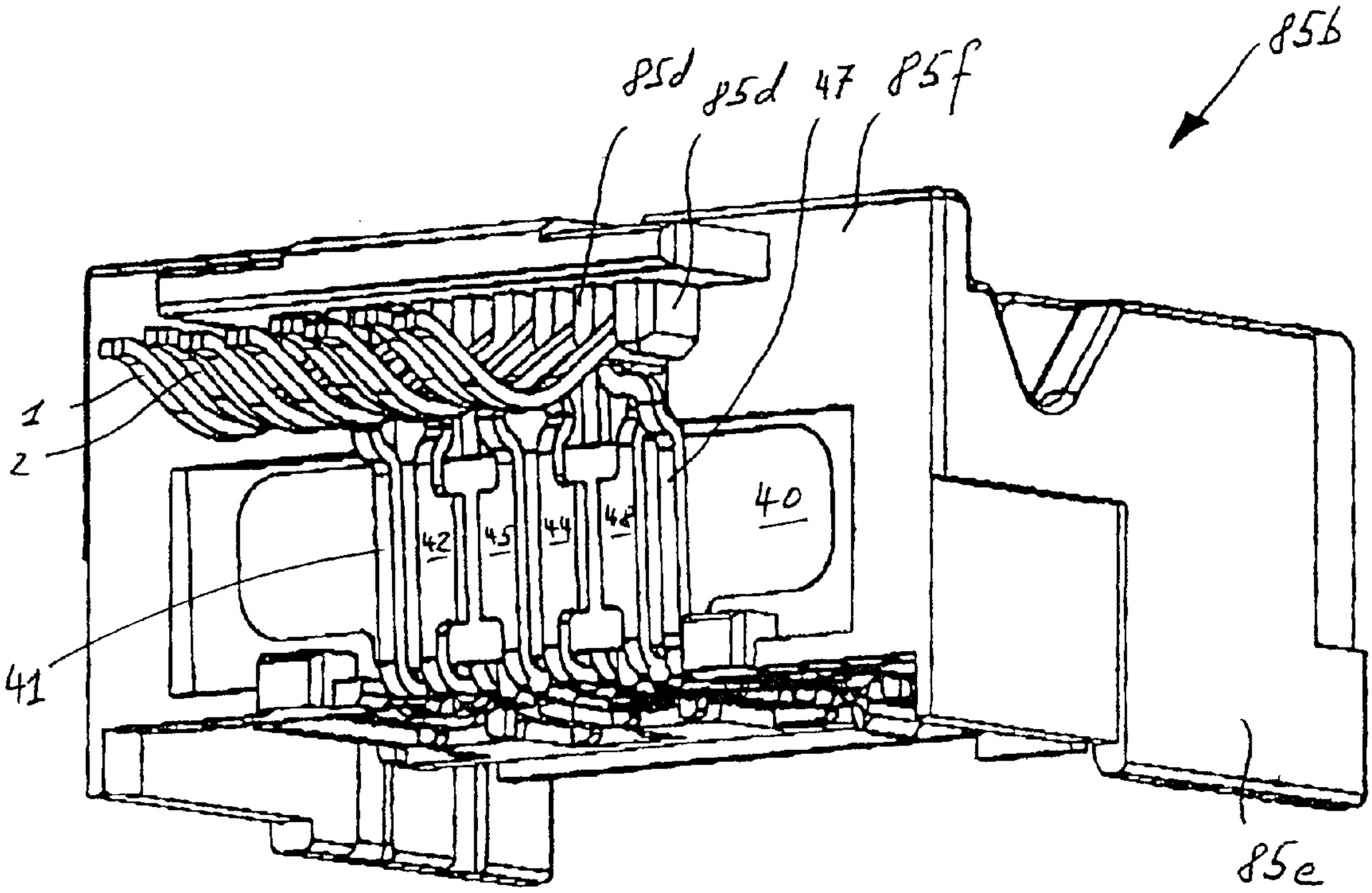

85d
85d
47
85f
85b
1
2
40
42
45
44
43
41
85e

Fig. 5

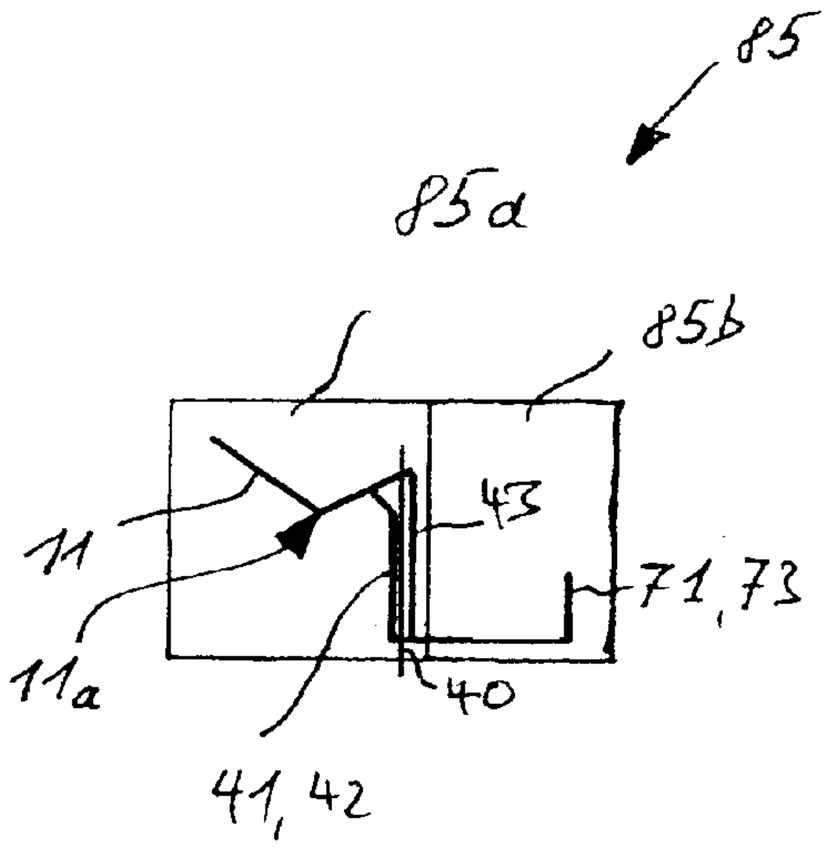

85
85a
85b
43
11
71, 73
11a
40
41, 42

Fig. 6

PLUG CONNECTOR PART

BACKGROUND OF THE INVENTION

The invention concerns a plug connector part, in particular for RJ45 plug connectors.

An RJ45 plug connector is standardized to DIN EN 60603 Part 7 IEC 60603-7 and used worldwide for plug connectors in communication and data networks. Conventional sockets for such RJ45 plug connectors have a standardized contact arrangement and opening geometry, also known as the plug face, and have cutting terminals or solder pins for connection of a data cable or for connection to a printed circuit board.

DESCRIPTION OF THE PRIOR ART

EP 0 955 703 A2discloses such a socket in which eight conductor paths are arranged essentially mutually parallel. This socket is designed for a bandwidth of category 5 (100 MHz bandwidth).

The disadvantage with this known socket is the fact that it is inadequate for electrical signals with a bandwidth above 100 MHz as between the conductor paths such a high cross-talk occurs that the signals transferred are unacceptably distorted. Because of the increasing bandwidth requirement in communication and data networks there is a need for the connectors of higher bandwidth. Therefore in the standardization group of the RJ45 standard a new category 6 has been defined which defines plug connectors with 200 MHz bandwidth.

The purpose of the present invention is to specify a plug connection part in particular for RJ45 plug connectors which has a lower cross-talk even for electrical signals with a bandwidth of at least 200 MHz.

SUMMARY OF THE INVENTION

The task is solved in particular with a plug connection part comprising a multiplicity of conductor paths which at one end have a contact spring and at the other end an output contact, where the contact springs run from the end facing away from the output contact towards the output contact, and where the conductor paths run at least partly mutually crossing in a compensation section after the contact springs, and the conductor paths lie above each other at least in part along a part length of the compensation section and run electrically separated by an insulator arranged in between.

The said standards for RJ45 plug connectors contain a definition for the structure of the plug face but there are no specifications for the course of the contacts beyond the plug area. Therefore RJ45 plug connectors with a multiplicity of differently arranged conductor paths are known. In particular for RJ45 connectors of category 5 it is known, for example from the said specification, to arrange the course of the conductor paths so that a targeted cross-talk compensation occurs. The common factor with all these plug connectors designed for signal bandwidth of 100 MHz is that they are scarcely or not at all suitable for higher bandwidths for the following physical reasons. The mechanical dimensions of these systems, in particular the distance between the plug and compensation and the extent of the compensations, are so great that even at high frequencies an additional phase offset occurs between the interference signal and the compensation signal, which restricts the effectiveness of the existing compensation for these frequencies.

Plug connection systems for a signal bandwidth of over 100 MHz must therefore be very thoughtfully designed for

physical reasons. In particular it must be remembered that the RJ45 standard prescribes a plug with parallel conductors and a spread pair 3/6 which inevitably leads to an increased cross-talk. An RJ45 plug connector for a high signal bandwidths can therefore be produced only if it is possible by suitable technical measures to achieve cross-talk compensation.

The plug connection part according to the invention has compensation for cross-talk, where the compensation is designed extremely compact and contains both capacitative and inductive coupling paths. The conductor paths of the plug connection part have a minimum physical extension. Also certain conductor paths are crossed and for mutual compensation run in two parallel planes where between these two parallel planes is arranged an electrical insulator or a dielectric in order to achieve an amplified capacitative coupling path.

One advantage of the plug connector comprising the plug connection part according to the invention is the fact that even at signals of 200 MHz bandwidth the cross-talk only has a value of max. −48 dB.

Another advantage is the fact that the plug connection part can be designed very compact and small. This allows existing sockets to be replaced by a socket with the broadband plug connection part according to the invention in order to increase the bandwidths of existing networks. The twisted pair electrical conductors permanently laid in a building need not be changed, which allows low-cost expansion of the bandwidth.

As well as the 8-pin design disclosed below, the plug connection part according to the invention can also be produced with another number of pins, for example in 6-pin design according to the RJ11 standard.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which

FIG. **1** is an RJ45 plug connector;

FIG. **2** is an first view of a plug connection part from direction B;

FIG. **3** is a second view of the plug connection part according to FIG. **2** from direction A;

FIG. **4***a* shows diagrammatically an 8-pin plug;

FIG. **4***b* shows diagrammatically in spread view, the course of the conductor paths in the plug connection part;

FIG. **5** shows a plug connection part arranged in a part housing; and

FIG. **6** shows diagrammatically a side view of the course of the conductor paths in the plug connection part.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** shows a computer **81** which is connected via a cable **82** to a communication network known as a LAN. At the end of the cable **82** is fitted an RJ45 plug **83** or an 8-pin module plug **83**. The cable **82** has 4 pairs of mutually twisted electrical conductors, known as "unshielded twisted pairs (UTP)" and for example is suitable for computer networks of high bandwidth or high speed. Behind a cover **84** is arranged the socket **85** or module socket **85** which holds a first part housing **85***a* with a cavity **85***c* for insertion of the plug **83** and a second part housing **85***b*.

FIG. **2** shows a plug connection part **80** from view direction B. Eight conductor paths **1–8** each have at one end a contact spring **11–18** and that the other end an output contact **71–78** which is designed as a cutting terminal. The contact springs **11–18** run along a contact spring section **19** into a common area and are mutually parallel. The contact springs **11–18** are designed V-shaped in their longitudinal direction and each have a contact point **11***a***–18***a* which, with the plug **83** inserted, lie on the relevant contact points of the plug **83**. The contact springs **11–18** start at one end facing away from the output contacts **71–78** and run towards the output contacts **71–78**. The contact springs **11–18** open into a deflection section **29** within which the conductor paths **1–8** are deflected around 90 degrees. Then follows a crossover section **39** within which the conductor pairs **1**,**2**; **4**,**5**; and **7**,**8** cross mutually. The conductor paths **1–8** then run in two parallel planes spaced apart essentially in the running direction of the contact springs **11–18** so that a section **49** of parallel and offset conductor paths **1–8** is formed. Between the two spaced planes is arranged an electrical insulator **40** which forms a dielectric. The part lengths **41–48** of the conductor paths **1–8** arranged in the section **49** are partly structured spread in the longitudinal direction of the insulator **40** to create a correspondingly larger capacitance. Also individual part lengths **41–48** are arranged opposite the insulator **40** in order again to achieve an increased capacitance between the conductor paths **1–8**. After the section **49** the conductor paths **1–8** open into a deflection section **59** within which the conductor paths **1–8** are deflected around 90 degrees. Then or coinciding with the deflection section **59** is arranged a crossover section **69** within which the conductor paths **1–8** cross as shown in FIG. **4***b* in the spread view. After the crossover section **69** is a cutting terminal area **79** with cutting terminal contacts **71–78**.

The course of the conductor paths **1–8** can be structured such that at least some of the conductor paths **1–8** cross mutually in the deflection section **29**, **59** so that the deflection section **29**, **59** also corresponds to the crossover section **39**, **69**.

FIG. **3** shows the plug connection part **80** shown in FIG. **2** from view direction A. The part lengths or shapes **43**, **46** of the conductor paths **3** and **6** are clearly visible in the area of the section **49**. The shapes **43**, **46**, separated only by the insulator **40**, lie opposite the shapes **42**, **45**, **44**, **48** and are arranged mutually parallel.

FIG. **4***a* shows in a top view the end of the plug **83** with the eight mutually parallel contact points **83***b* which extend over a length **83***a*. FIG. **4***b* shows the course of the conductor paths **1–8** spread in one plane and here in particular the crossover of the conductor paths **1–8** in the plug connection part **80** is clear. The very short contact spring section **19** opens into the crossover section **39** in which the conductor paths **1**,**2**; **4**,**5** and **7**,**8** mutually cross. The conductor paths **1–8** in section **49** run essentially mutually parallel and as shown in FIGS. **2**, **3** and **6**, in two mutually spaced planes. After the crossover section **69** the conductor paths **1–8** end in the cutting terminal area **79**. Sections **39**, **49** and **69** together form a compensation section **99** within which a targeted crosstalk compensation is achieved.

FIG. **6** shows diagrammatically a side view of the socket **85** with the first part housing **85***a* and second part housing **85***b*. All contact springs **11–18** run in the same plane where only the contact spring **11** with contact point **11***a* is marked. At the deflection point **29** the course of the conductor paths **1–8** changes by around 90 degrees in relation to the alignment of the contact springs **11–18**. The conductor paths **1–8** then run in two parallel planes where in the one plane the conductor path sections **41**, **42** and in the other plane the conductor path section **43** are shown. Between these two planes is arranged the insulator **40**. This insulator **40** acting as a dielectric can for example be designed as a film, in particular a Poly-Ethylene-Terephthalate (PET) film. In a preferred embodiment the film has a thickness of less than 0.3 mm.

FIG. **5** shows the perspective view of a second part housing **85***b* with part housing wall **85***e* and front wall **85***f*, where in this part housing **85***b* is arranged the plug connection part **80**. The conductors **1–8** are held in the deflection section **29** between the holders **85***d* of the second housing part **85***b*. The insulator **40** lies on the front wall **85***f*. The part housing **85***b*, as shown in FIG. **6**, together with the first part housing **85***a* can be assembled into a socket **85**. As the section **49** or compensation section **99** is arranged essentially vertical to the longitudinal direction of the socket **85**, socket **85** is very short and compact in a longitudinal direction. As the section **49** or compensation section **99** is arranged approximately in the centre in relation to the longitudinal direction of the socket **85**, the electrical compensation is not sensitive to metallic screening surfaces which can be fitted outside on the socket **85** to utilize the Faraday effect. This gives this advantage that the same plug connection part **80** can be used for both screened and unscreened plug systems.

Instead of the cutting terminals solder pins can be provided as output contacts **71–78**.

In a further embodiment the crossover section **69** can be omitted so that the plug connection part **80** has conductor paths **1–8** crossing only in the crossing section **39**.

In a further embodiment the conductor paths **1–8** can be formed such that, in the side view in FIG. **6**, they have an essentially Z-shaped course.

I claim:

1. A plug connection part, in particular for RJ45 plug connectors, comprising a multiplicity of conductor paths each having one end with a contact spring and another end with an output contact, where the contact springs run starting from an end facing away from the output contact towards the output contact, wherein, in a first cross-over section following the contact springs, portions of selected ones of the conductor paths cross portions of selected others of the conductor paths, and in a second cross-over section, remote from said first cross-over section, other portions of selected ones of the conductor paths cross further portions of selected others of the conductor paths, said first and second cross-over sections comprising a compensation section, wherein along a part length of the compensation section between said first and second cross-over sections at least two of the conductor paths run in a first plane and a plurality of others of the conductor paths run in a second plane parallel to said first plane, said first and second planes electrically separated by an insulator disposed there-between, and wherein said first and second cross-over sections do not have said insulator disposed between the respective crossed portions of the conductor paths thereof.

2. A plug connection part according to claim **1**, wherein the contact springs run into a common area.

3. A plug connection part according to claim **1**, wherein the contact springs are V-shaped in the direction of running of the conductor paths.

4. A plug connection part according to claim **1**, wherein the conductor paths in the area of the insulator have shapes defining the areas that are dimensioned so that between certain conductor paths a prespecified capacitance is present.

5. A plug connection part according to claim **1**, wherein the insulator is arranged running essentially vertically to the contact springs.

6. A plug connection part according to claim **1**, wherein pairs of the conductor paths run crossed within the compensation section.

7. A plug connection part according to claim **1**, wherein the output contact is a cutting terminal.

8. A plug connection part according to claim **1**, wherein the output contact is a solder pin.

9. A plug connection part according to claim **1**, wherein the insulator is formed as a PET film and has a thickness of less than 0.3 mm.

10. A plug connection part according to claim **1**, wherein the conductor paths run in an essentially Z-shaped course.

11. A plug connection part according to claim **1**, wherein each of the conductor paths along a part length of the compensation section runs in one of two parallel planes between which is arranged the insulator.

12. A plug connection part according to claim **11**, wherein a third and a sixth conductor path along said part length of said compensation section runs in said first plane; and a first, a second, a fourth, a fifth, a seventh and an eight conductor path along said part length of said compensation section runs in said second plane.

13. A socket comprising a plug connection part, the plug connection part comprising a multiplicity of conductor paths

each having one end with a contact spring and another end with an output contact, where the contact springs run starting from an end facing away from the output contact towards the output contact, wherein, in a first cross-over section following the contact springs, portions of selected ones of the conductor paths cross portions of selected others of the conductor paths, and in a second cross-over section, remote from said first cross-over section, other portions of selected ones of the conductor paths cross further portions of selected others of the conductor paths, said first and second cross-over sections comprising a compensation section, wherein along a part length of the compensation section between said first and second cross-over sections at least two of the conductor paths run in a first plane and a plurality of others of the conductor paths run in a second plane parallel to said first plane, said first and second planes electrically separated by an insulator disposed there-between, and wherein said first and second cross-over sections do not have said insulator disposed between the respective crossed portions of the conductor paths thereof.

* * * * *